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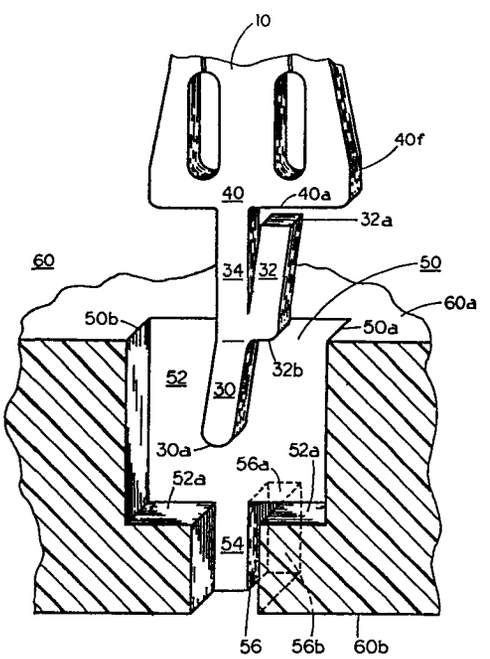
(71) Applicant: **Reliance Electric Company, 29325 Chagrin Blvd., Cleveland, Ohio 44122 (US)**

(72) Inventor: **Suffi, Louis, 2837 Kensington, Westchester Illinois 60153 (US)**

(74) Representative: **Mitchell, Alan et al, ESSO Engineering (Europe) Ltd. Patents & Licences Apex Tower High Street, New Malden Surrey KT3 4DJ (GB)**

(54) Electrical connector.

(57) A connector (10) for electrical conductors of the type capable of being mounted in an aperture (52) of a non-conductive block includes a spring (32) which cooperates with a cavity (56) in the aperture (52) in which it is mounted to allow the connector to be retained therein. The spring is movable to release it from engagement with the cavity to allow the connector to be removed from the aperture.



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ELECTRICAL CONNECTOR

This invention relates to an improved electrical connector and more particularly to a means which allows the connector to be retained in a slot or aperture into which it is inserted while at the same time allowing for the connector to be easily removed or disengaged from the slot.

Terminal connecting blocks are used extensively in the fields of electronics and communications. For example, they are used by the telephone industry in distribution cabinets for connecting conductors in a cable from an exchange to other conductors extending to various stations within a building. Such connecting blocks should be as compact as possible so as to take up a minimum amount of space while providing means for making a large number of connections. The connectors should be easily insertable in the block, be retained in the block without excessive motion once they are inserted, and readily removable without causing harm to the block.

Connectors which provide connections for one or more conductors are well known. Most of those connectors which provide connections for a multiple number of conductors are of the type which comprise two or more beam type spring members attached to the main body of the connector. Examples of such connectors are shown in

U.S. Patent Numbers 3,605,071 which issued on September 14, 1971 and 3,761,866 which issued on September 25, 1973 both in the name of William Sedlacek. Further examples of such connectors are shown in U.S. Patent Number 4,350,405 which issued on September 21, 1982 in the name of C. Yapoudjian et al and U.S. Patent Number 4,421,374 which issued on December 20, 1983 in the name of L. Montilla Jr., et al.

According to the invention there is provided an electrical connector of electrically conductive material, said connector being characterised in that it comprises a conductor connection portion extending in one direction and having a base portion at one end for receiving at least one electrical conductor in electrical connection therewith; an intermediate portion having two ends, one of said ends being connected to said conductor connection portion at said base portion and being unitary therewith, said intermediate portion extending from said conductor connection portion in a direction which is substantially opposite the direction in which said conductor connection portion extends; and spring means having a predetermined length and connected at one end to said intermediate portion at the other of the two ends of said intermediate portion in a manner such that said spring means extends outwardly therefrom toward said base portion of the conductor connection portion, said predetermined length being such that said spring means terminates at its free end short of said base portion of said conductor connection portion.

The invention also provides a connector assembly comprising a supporting block of electrically insulative material having an aperture therein in which an electrical connector as defined in the preceding paragraph is mounted with the spring means thereof positioned inside and engaged within a cavity of the aperture.

The invention will be better understood by referring, by way of example, to the following description and the accompanying drawings, wherein:

Fig. 1 is a front elevational view of one form of electrical connector of the present invention.

Fig. 2 is a side elevational view of the connector in Fig. 1.

Fig. 3 is a perspective view of a terminal block having a plurality of apertures in which a plurality of electrical connectors are mounted.

Figs. 4a and 4b are cross-sectional views of the opposite sides of an aperture of the block of Fig. 3.

Referring to Figs. 1 and 2 there is shown an electrical connector 10 of the type which provides connections for a multiple number of conductors in the form of an integral spring metal piece. The connector 10 may be constructed of any suitable resilient conducting material. The connector may be formed by known metal stamping methods.

The connector is comprised of a flat base portion 40 and three contact fingers projecting therefrom. The fingers include a symmetrical center finger 14 and left side and right side fingers 12 and 16, respectively. Slots are provided between the fingers, left slot 22 having a first portion 22a and a second portion 22b and right slot 24 having a first portion 24a and a second portion 24b.

The tips of the left and center fingers define an essentially V-shaped tapered mouth 26 for slot 22. The tips of the center and right fingers also define an essentially V-shaped tapered mouth 28 for slot 24. The mouths 26 and 28 facilitate the introduction of an electrical conductor (not shown) into its associated slot. As is well known in the art when such a conductor is pushed into slot 22 or 24, the respective resilient side finger 12 or 16 and the center finger 14 are pushed apart. The electrical insulation on the conductor is crushed and abraded away so as to cause an electrical contact between the connector 10 and the conductor.

Center finger 14 also includes crushed portions 14a and 14b. These crushed portions form associated bosses 14c and 14d, respectively. These bosses allow for better retention of a conductor inserted in slot 22 or 24 in that the projection of the associated crushed portion 14a or 14b forms a mechanical abutment. This abutment is in addition to the mechanical pressure exerted on the conductor by the fingers of the connection fork.

The lower end of the connector may include a terminal end 30 to permit a soldered connection or a wire wrapped connection. The terminal 30 is joined to base 40 by an intermediate part 34 of connector 10 and lies in a plane which is at a shallow acute angle with respect to the plane in which base portion 40 lies. At a point approximately halfway from base portion 40 toward rounded edge 30a of terminal end 30, connector 10 includes a cantilever spring member 32. Spring member 32 extends outwardly from the interface between terminal end 30 and intermediate part 34 toward flat base portion 40. Spring member 32 lies in a plane which is at a shallow acute angle with respect to the plane in which base portion 40 lies, and extends in the opposite direction to terminal end 30. This angle is sufficient, however, to allow member 32 to pass beyond the thickness 40f of base portion 40. The length of spring member 32 is such that its upper edge 32a falls just below the lower edge 40a of base portion 40. In this manner the base portion does not interfere with the operation of the cantilever spring.

Referring to Fig. 3 there is shown a perspective view of a connector block 60 having a plurality of apertures or slots 50 in which the connectors 10 are mounted. The block 60 which has a top surface 60a and a bottom surface 60b, may be formed of a suitable elec-

trical insulating material such as a plastic, e.g., polycarbonate resin. The block 60 contains a multiplicity of slots 50 extending through the thickness of the block. The slots 50 are adapted to receive the connector 10. These slots are arranged in a geometrical pattern designed to accommodate a maximum number of connectors in a minimum amount of space.

Referring to Figs. 4a and 4b, there is shown a cross-section of one slot 50 in block 60. Fig. 4a shows the cross-section looking in one direction. Fig. 4b shows the cross-section looking in the opposite direction. A portion of connector 10 is shown in Fig. 4a but has been omitted from Fig. 4b for ease of illustration. Slot 50 includes a first substantially rectangular shaped portion 52 which is adapted to accept base portion 40 of connector 10. The dimensions of the portion 52 are such that the lower edge 40a of base portion 40 abuts the bottom edge 52a of portion when the connector is fully inserted in the slot. The dimensions of the first portion 52 and the connector 10 are also such that when the connector is fully inserted in slot 50 only the first portion 22a, 24a and tips of the fingers 12, 14, 16 (see Fig. 1) project beyond the top surface 60a of the block.

Slot 50 includes a second portion 54 which lies below first portion 52. The portion 54 is adapted to accept that part of the connector 10 which lies below base 40. Portion 54 is in effect an extension of and lies in the same plane as portion 52. Slot 50 further includes, as shown in Fig. 4a, a cavity 56 which is adapted to receive cantilever spring member 32. Cavity 56 is essentially rectangular and is recessed at a predetermined depth from portions 52 and 54. The depth of

cavity 56 is such that the upper edge 32a of angled spring member 32 clears the upper end 56a of the cavity when connector 10 is fully seated in slot 50. Cavity 56 is windowless in that block 60 is solid as shown in Fig. 3.

As described above, terminal end 30 is formed at an angle opposite to the angle at which spring member 32 is formed. End 30 is formed in this manner for a predetermined angle in order that it match or exceed the depth of portion 52. The advantage in forming end 30 in this manner is that it facilitates insertion of the connector in the slot. When connector 10 is inserted into portion 52, angled end 30 is forced against surface 54a of portion 54 (see Fig. 4b). In this manner end 30 will not slide into cavity 56 and become lodged therein. The lodging of end 30 in cavity 56 might occur if end 30 were not at an angle with respect to base portion 40. In that case it would become necessary to apply increased external force to connector 10 in order to dislodge end 30 from cavity 56. Thus the angling of terminal end 30, while not critical to the invention, does allow for ease of insertion of the connector into the slot.

Portion 54 and cavity 56 are equal in length and that length is such that when the connector is fully seated in the slot the lower edge 32b of the spring member and the portion of terminal end 30 adjacent thereto both project beyond the bottom surface 60b of the block. As described above, the spring member 32 is angled downward from its lower edge 32b toward the back end 56b of cavity 56. The upper and lower edges, 32a and 32b, respectively, of spring member 32 do not ordinarily contact the back end 56b. The space between the lower edge of the spring member and end 56b allows an appropriately shaped tool to be inserted into cavity

56 from the bottom surface of the block. The tool is used to force spring member 32 upwardly such that its upper edge 32a clears the upper end 56a of the cavity. In this manner connector 10 can then easily be removed from slot 50 by sliding the connector upwardly toward the top surface of the block.

As shown in the figures, connector 10 may include rounded edge 30a on its terminal end 30, a rounded edge for lower edge 32b of spring member 32, and rounded edges 40b, 40c, 40d and 40e on its base portion 40. It has been found that the use of such rounded edges facilitates insertion of the connector into its associated slot. Slot 50 may also include rounded edges (not shown) for one or more of the edges designated as 50a and 50b in Figs. 4a and 4b. These rounded edges also facilitate insertion of the connector in the slot.

While the electrical connector has been shown with a wire wrap terminal 30 which lies at a shallow acute angle with respect to the plane in which the base portion lies, it should be appreciated that the wire wrap terminal can lie in the same plane as the base portion does. Using an unangled terminal end 30 does not substantially affect the ease with which the connector can be inserted into the slot. It should also be appreciated that end 30 may also take anyone of a number of forms well known in the art in addition to the wire wrap terminal illustrated in Fig. 1.

CLAIMS:

1. An electrical connector of electrically conductive material, said connector being characterised in that it comprises a conductor connection portion (40,12,14,16) extending in one direction and having a base portion (40) at one end for receiving at least one electrical conductor in electrical connection therewith; an intermediate portion (34) having two ends, one of said ends being connected to said conductor connection portion at said base portion and being unitary therewith, said intermediate portion extending from said conductor connection portion in a direction which is substantially opposite the direction in which said conductor connection portion extends; and spring means (32) having a predetermined length and connected at one end to said intermediate portion at the other of the two ends of said intermediate portion in a manner such that said spring means extends outwardly therefrom toward said base portion of the conductor connection portion, said predetermined length being such that said spring means terminates at its free end (32a) short of said base portion of said conductor connection portion.

2. A connector as claimed in claim 1, wherein said electrical conductor is made from sheet material which is electrically conductive and wherein said spring means (32) lies in a plane which is at a shallow acute angle with respect to the plane in which said conductor connection portion lies.

3. A connector as claimed in claim 1 or 2, wherein said connector further includes a further conductor connection portion (30) connected to said

intermediate portion at said other end thereof and unitary therewith and extending in a direction which is substantially opposite the direction in which said first-mentioned conductor connection portion extends.

4. A connector as claimed in claim 3 wherein said second-mentioned conductor connection portion (30) lies in a plane which is at a shallow acute angle with respect to the plane in which said first-mentioned conductor connection portion lies.

5. A connector as claimed in any preceding claim, wherein said-first mentioned conductor connection portion includes:

i) a generally planar base portion (40) having two ends, one of which is connected to said intermediate portion (34);

ii) a double fork connection portion which is connected to the other of said ends of said generally planar base portion (40), said double fork connection portion being generally coplanar and unitary with said generally planar base portion and comprising:

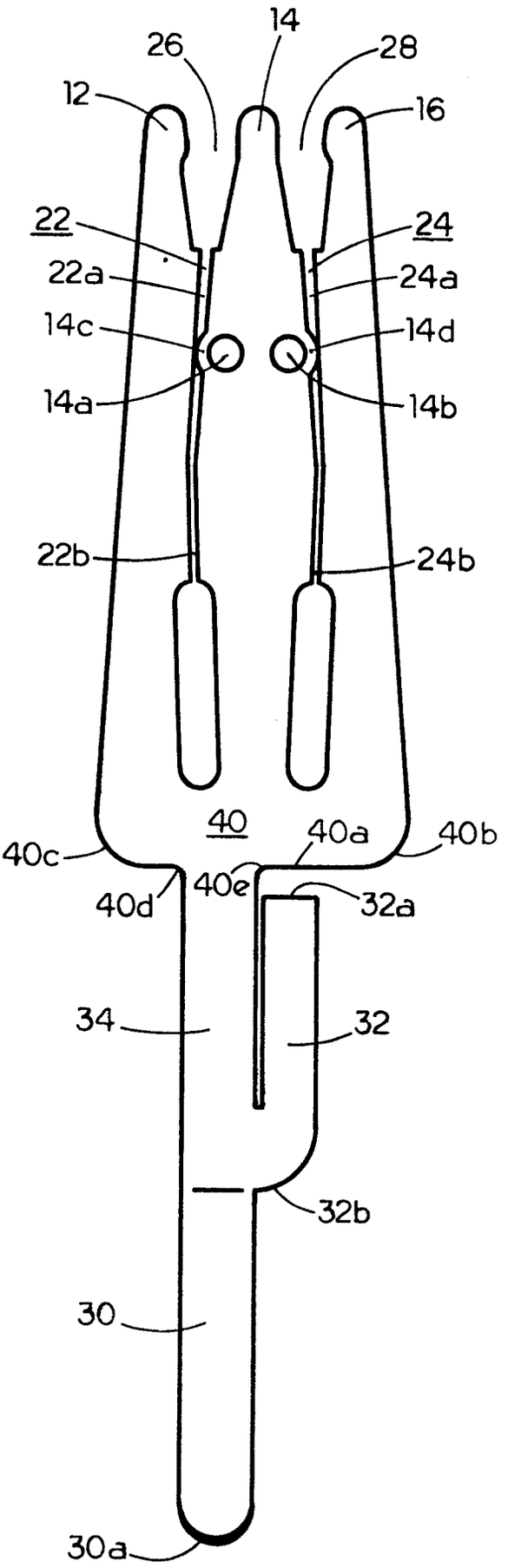
a) a central arm (14); and

b) two resiliently movable side arms (12,16) with conductor receiving elongated slots (22,24) between said central arm and said side arms, the other of said ends being connected to said intermediate portion (34).

6. A connector assembly comprising a supporting block of electrically insulative material having an aperture (50) therein in which a connector

according to any preceding claim is mounted with said spring means positioned inside and engaged within a cavity (56) of said aperture.

7. A connector assembly as claimed in claim 6, wherein said supporting block is made of a plastics material and has a plurality of connector receiving generally rectangular shaped apertures (50) that are arranged in a predetermined geometrical pattern and which open to the top and bottom surfaces (60a, 60b) of said block, said cavity (56) of each of said apertures being a windowless cavity which extends in a direction laterally of the width of said apertures, said cavity extending from said bottom surface (60b) towards said top surface (60a) a predetermined distance which is less than the thickness of said block and wherein a plurality of electrical connectors (10) is provided, each being mounted in one of said apertures, said spring means cooperating with portions of said supporting block which defines said cavity of the aperture in which said connector is mounted to prevent substantially movement of said connector along the width of said first-mentioned conductor connection portions and to allow substantial portions of said first-mentioned conductor connection portion to extend beyond said top surface while anchoring said connector when an electrical conductor is connected to said first-mentioned conductor connection portion, said spring means further being adapted to be movable in order to disengage said spring means from its associated cavity and thereby enable said connector to be removed from said aperture in which it is mounted.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16
22
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22a
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14c
14d
14a
14b
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32
32b
30
30a

Fig.1

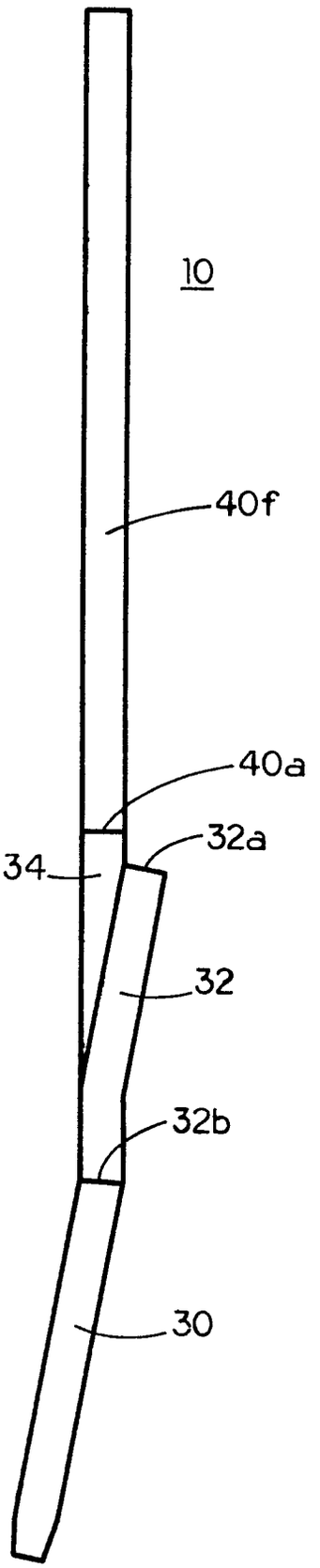
10
40f
40a
32a
34
32
32b
30

Fig.2

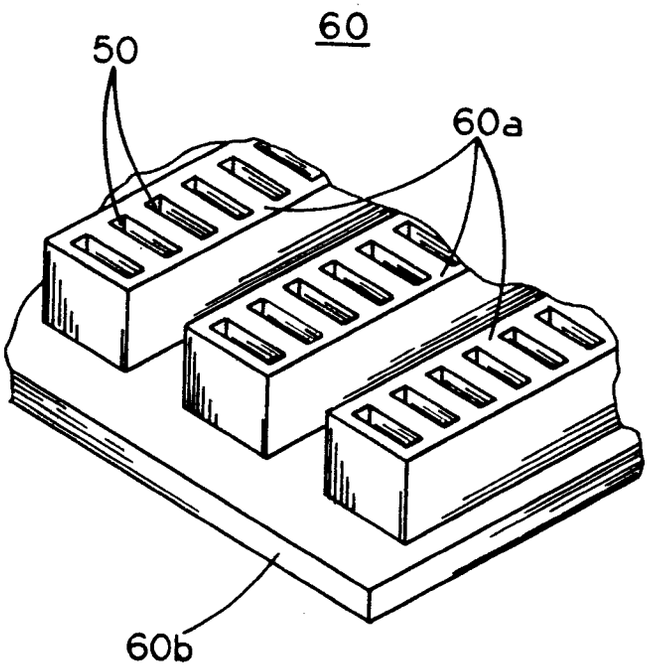

Fig. 3

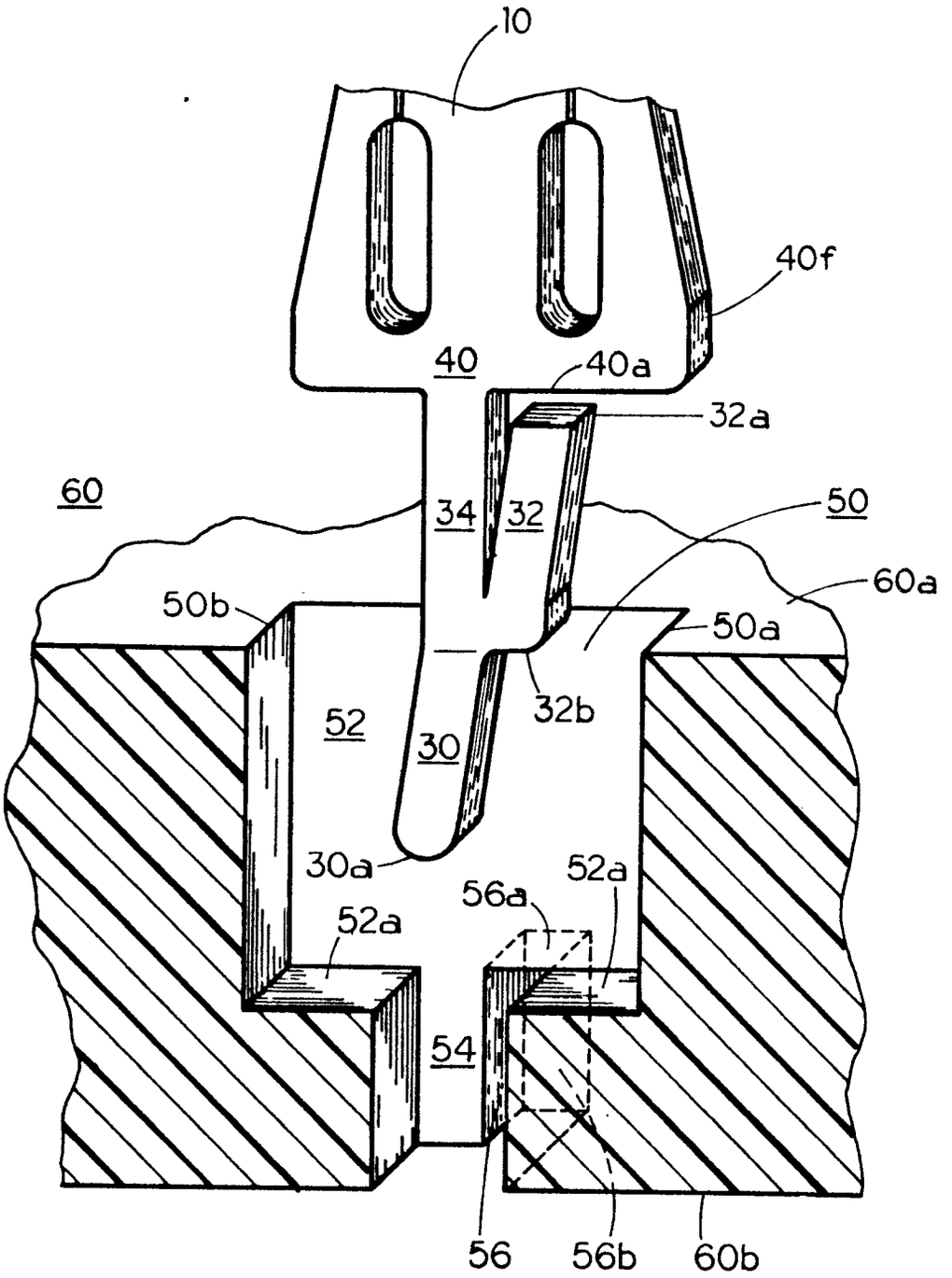
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Fig. 4a

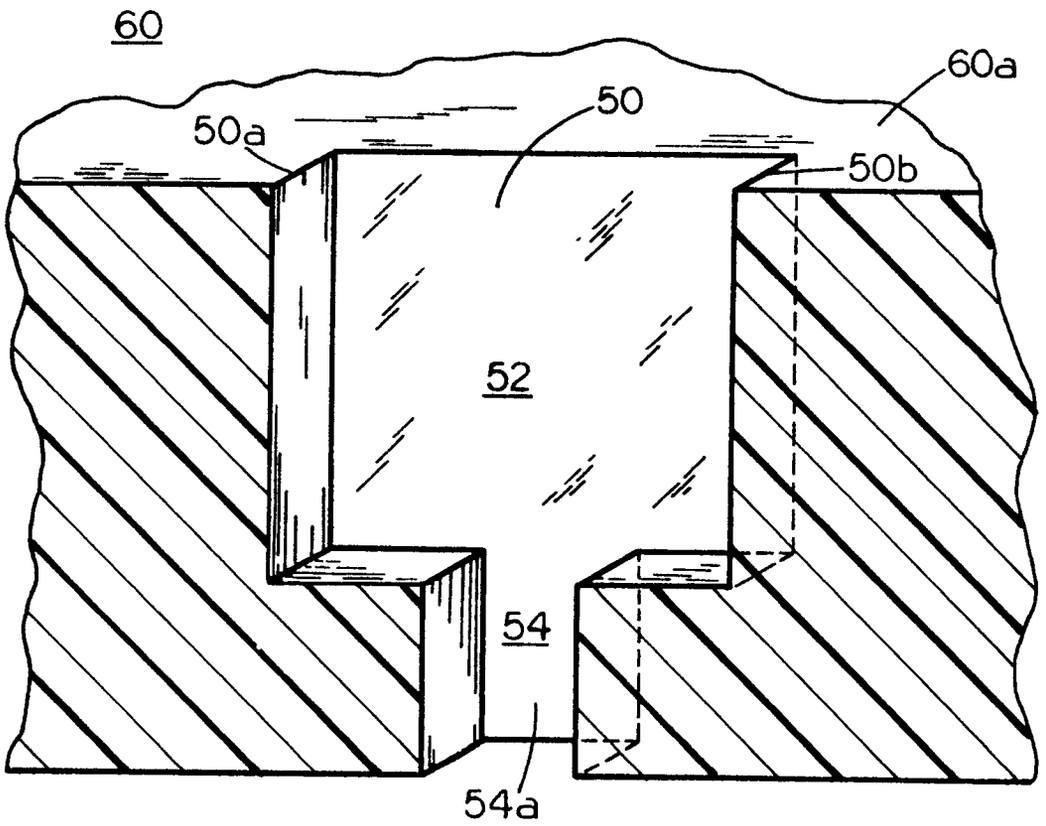

Fig. 4b